Appendix F.7:
Dam Failure

Vulnerability Assessment Parameters, Methodology and Results

The dam failure hazard vulnerability assessment of State-owned buildings and critical facilities in Louisiana involved an analysis of potential inundation areas from all possible dam failures statewide. The potential inundation areas were estimated based on an algorithm which distributed dam capacities provided by the State over a failure hazard radius of a selected depth around each dam. The results were then used to prepare dam failure hazard zones based on proximity to the failure hazard radii computed by the algorithms.

Based on this information, a hazard vulnerability assessment level (low, medium or high) was assigned for each of the State-owned buildings and critical facilities. The three hazard vulnerability levels are defined below.

- Low Hazard Vulnerability: Structures located outside the dam failure hazard radius.
- Medium Hazard Vulnerability: Structures located within the area greater than 50% but less than 100% of the dam failure hazard radius.
- High Hazard Vulnerability: Structures located within the area less than or equal to 50% of the dam failure hazard radius.

Map 4-12, Hazard Profile – Dam Failure, shows the locations of various dams in parishes throughout the State of Louisiana. Map F-116 indicates the location of State-owned critical facilities in Louisiana in relation to the dam failure hazard radii.

Map F-117 shows State-owned critical facilities by level of vulnerability to the dam failure hazard.

Loss Estimate Parameters, Methodology and Results

The dam failure loss estimate of State-owned buildings and critical facilities in Louisiana involved an analysis of the parameters described below.

- Dam Failure Hazard Vulnerability: As stated above, dam failure hazard vulnerability assessments involved an analysis of potential inundation zones prepared by an algorithm which distributed dam capacities provided by the State over a failure hazard radius around each dam. Low, medium, and high dam failure vulnerability for dam failure are defined above.
- Average Inundation Depth: The dam failure hazard radii were estimated based on an algorithm that distributed dam capacities over a radius with an average inundation depth of 3 feet. The actual inundation depths for individual State-owned buildings and critical facilities could not be determined due to the lack of available first floor elevations for each structure. Therefore, the average inundation depths for individual structures were estimated at 3 feet based on the corresponding dam failure hazard vulnerability level, as summarized below.
    - For low hazard vulnerability structures, no dam failure inundation depth was used since the structures were located outside the dam failure hazard radius.
    - For medium hazard vulnerability structures, an average dam failure inundation depth of 3 feet above the first floor was estimated assuming A Zone conditions, since the average dam failure inundation depth of 3 feet is assumed to be distributed equally and moving at a lower velocity within the area between 50% and 100% of the dam failure hazard radius.

- For high hazard vulnerability structures, an average dam failure inundation depth of 3 feet above the first floor was estimated assuming V Zone conditions, since the average dam failure inundation depth of 3 feet is assumed to be distributed equally and moving at a high velocity within 50% of the dam failure hazard radius.

- Average Building Type: Although the building types for each structure were described in the statewide GIS database, an analysis of all building types for individual State-owned buildings and critical facilities was beyond the scope of this loss estimate. Therefore, in order to conduct basic analyses, individual loss estimates assumed an average building type of a single story structure without a basement. This average building type was determined based on experience with typical buildings and foundation construction techniques in Louisiana.

- Inundation Depth-Damage Functions (IDDFs): Physical (building) damage, contents damage and LOF costs for each structure were estimated based on a series of IDDFs. These IDDFs were a combination of DDFs developed by the FIA based on nationwide flood claims data and damage functions for FEMA's *Full Data Benefit-Cost Module for Coastal V-Zone Flood* (version 5.2.2 dated December 31, 1998). The IDDFs for building damage, contents damage and LOF days used for the dam failure loss estimates are summarized in Table F.7-1.

Table F.7-1

Dam/Levee Failure Hazard Vulnerability Level	Average Building Type	Average Inundation Depth (above FFE)	Building IDDF (%BRV)	Contents IDDF (%BRV)	LOF (days)
Low	1 Story without Basement	None	0.0%	0.0%	0
Medium	1 Story without Basement	3 feet (A Zone)	27.0%	20.5%	27
High	1 Story without Basement	3 feet (V Zone)	50.0%	25.0%	30

NOTES: 1.) FFE = First Floor Elevation
2.) Assume contents replacement value = 50% BRV

- Physical Damage: Physical damages were estimated as a percentage of the BRV. For each structure, the BRV was determined based on building values obtained from the statewide GIS database. The physical damage costs were computed by multiplying the BRV by the corresponding building IDDF.

- Contents Damage: Contents damages were estimated as a percentage of the contents replacement value. For each structure, the contents replacement value was estimated based on a percentage of the BRV determined from the statewide GIS database. Based on an analysis of HAZUS data for various building types, the contents replacement values were equal to an average of 50 % of the BRVs. The contents damage costs were determined by multiplying the contents replacement value by the corresponding contents IDDF.

- LOF: LOF costs were estimated as a proportion of the annual operating budget for each structure. The annual operating budgets for each facility were determined as a proportion of the current annual operating budget for the State of Louisiana. This annual operating budget, currently estimated at approximately $16.0 billion, was distributed to individual State-owned buildings and critical facilities based on the *factored square footage* of each structure. The factored square footage for each structure was determined by multiplying the actual square footage by a CF based on the criticality of each structure. A summary of CFs for all structures in Louisiana is provided in Table F.1-2. Note that by applying the CF to the square footage of each structure, it allows higher criticality facilities (such as fire stations) to obtain a larger proportion of the statewide annual budget, thereby increasing their annual budget values and LOF costs to reflect their importance. Once the annual operating budget was obtained for each structure, the LOF costs were computed by dividing the annual operating budget by 365 (to convert the annual budget to a daily budget) and multiplying by the corresponding IDDF for LOF (measured in days).

Once these parameters were determined, the combined loss estimate (building, contents, and loss of function) in dollars for each structure was determined using the following formula:

Combined Loss Estimate = (Physical Damage + Contents Damage + LOF)

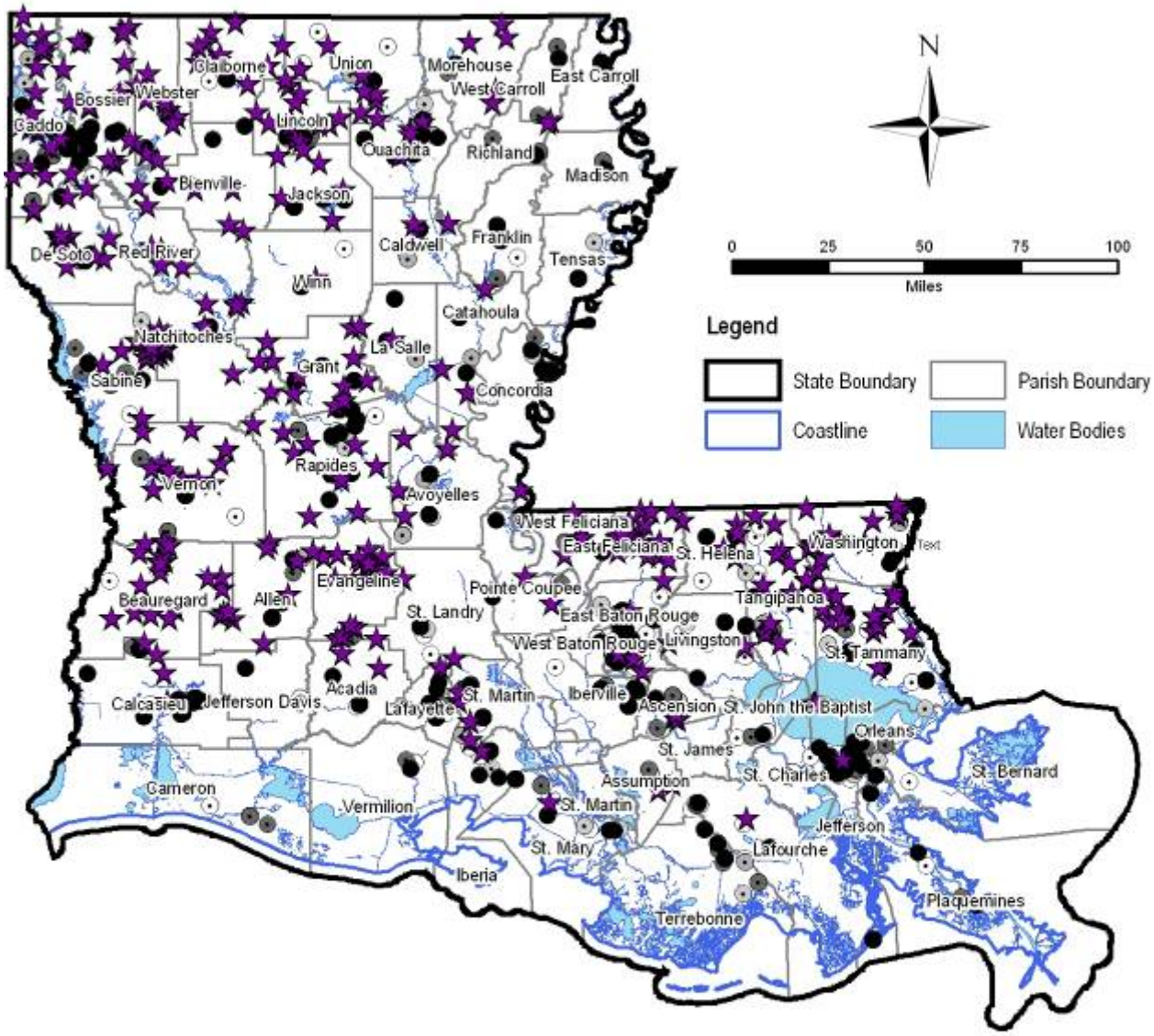
The critical facilities in Louisiana with highest physical damage, contents damage and LOF costs for dam failure are presented in Maps F-118, F-119 and F-120 respectively. Map F-121 (also Map 6-10) presents the results of the combined dam failure loss estimate computations. The ten critical facilities in Louisiana with the highest combined loss estimates for the dam failure hazard are shown on Map F-122 (also Map 6-10) and are summarized in Table 6-24. State-owned critical facilities for each agency in Louisiana with the highest combined loss estimates for the dam failure hazard are presented in Maps F-123 thru F-131.

List of Assumptions

The dam failure loss estimate is based on the following assumptions.

- General: Dam failure hazard loss estimates are based on an algorithm that distributed dam capacities provided by the State over a failure hazard radius of a selected depth around each dam. In addition, for high hazard dams in Louisiana, dam failure loss estimates were refined based on the dam failure hazard radius originating at the dam and spreading out in direction of the dam flow in an arc equal to one-fourth of the circular area defined by the failure hazard radius. In either case, note that the assigning of numerical values and factors for loss estimate parameters is often qualitative in nature and based on data from a number of sources with varying degrees of accuracy. For this reason, dam failure loss estimates for individual structures should not be used for estimating flood insurance coverage or other needs that require a high degree of accuracy.
- Dam Failure Hazard Vulnerability and Average Inundation Depth: No dam failure effects are experienced by structures constructed outside dam failure zones. Dam failure effects equivalent to 3 feet of water above the first floor elevation moving at low velocity without significant wave effects (A Zone) are experienced by structures in dam failure zones within the area between 50% and 100% of the dam failure hazard radius. Dam failure effects equivalent to 3 feet of water above the first floor elevation moving at high velocity with significant wave effects (V Zone) are experienced by structures in dam failure zones within 50% of the dam failure hazard radius or within the one-fourth circular arc defined by the failure hazard radius for high hazard dams. The average inundation depth of 3 feet was selected based on engineering judgment and experience with similar hazards.
- Average Building Type and IDDFs: The physical and contents damages to individual State-owned buildings and critical facilities from dam failure will be considered the same as a single story structure without a basement (i.e., slab-on-grade) constructed using standard residential building materials without obstructions to dam failure inundation such as berms or retaining walls.
- Physical Damage: For each structure, the BRV is consistent with the building values obtained from the statewide GIS database. In the event the statewide GIS database did not provide a BRV for an individual structure, the BRV was estimated to be zero.
- Contents Damage: For each structure, the contents replacement value is equal to 50 percent of the BRV.
- LOF: The $16.0 billion current annual operating budget for the State of Louisiana is distributed among all State-owned buildings and critical facilities in the statewide GIS database based on the factored square footage of each structure. In the event the statewide GIS database did not provide a square footage and/or criticality level for an individual structure, that square footage and/or criticality level was estimated based on the average square footage and/or criticality level for all structures in the statewide GIS database with available data. The Criticality Factors were derived based loosely on FEMA's *What is a Benefit?* draft guidance document dated May 1, 2001 and engineering judgment.

Map F-116: Location of Critical Facilities - Dam Failure



State-Owned Critical Facilities

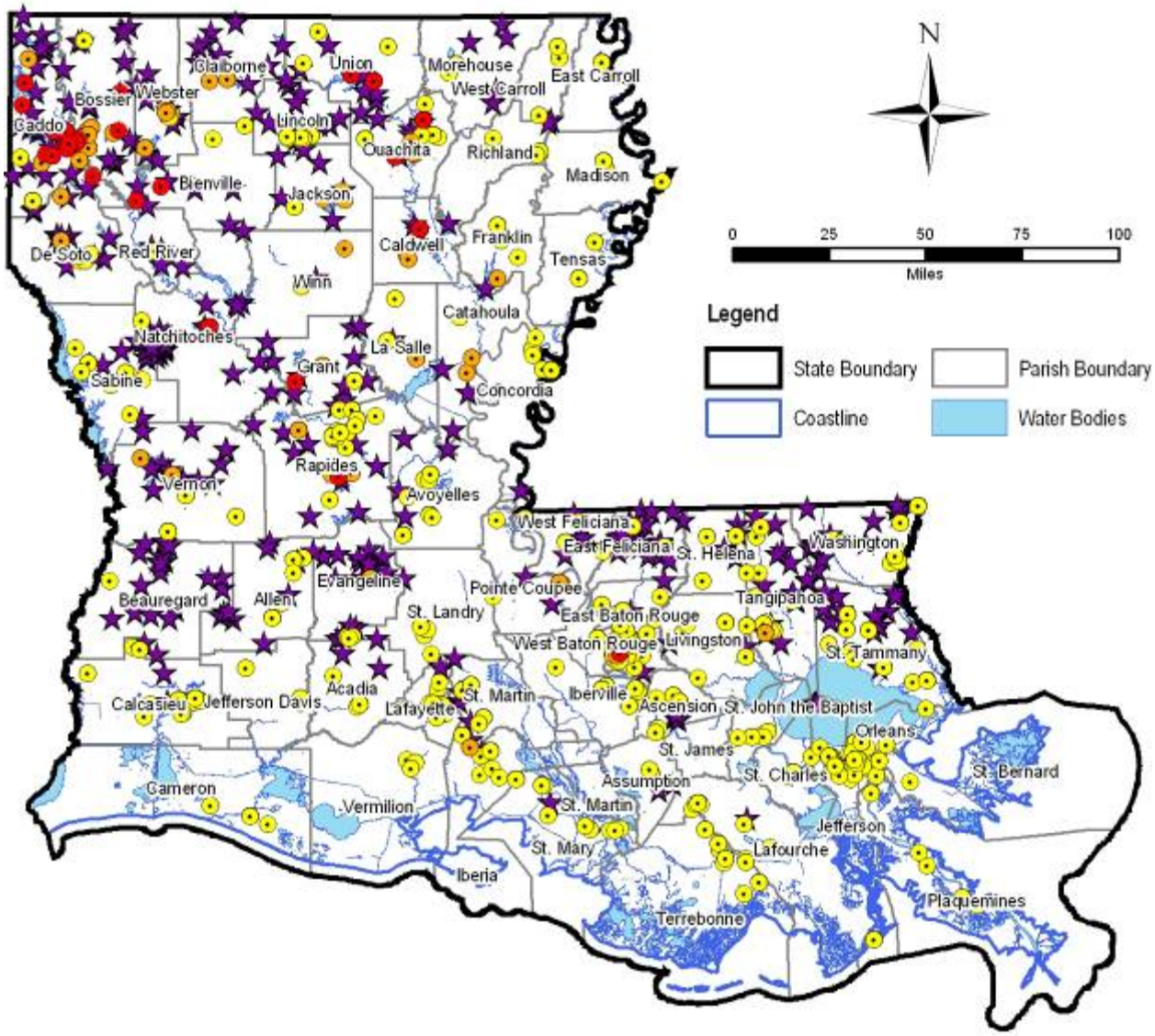
● 1 (High) ● 2 (Medium-High) ● 3 (Medium) ● 4 (Medium-Low) ● 5 (Low)

Source: Louisiana Facility Management Database

★ Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-117: Vulnerability Assessment - Dam Failure



Vulnerability; State-Owned Critical Facilities

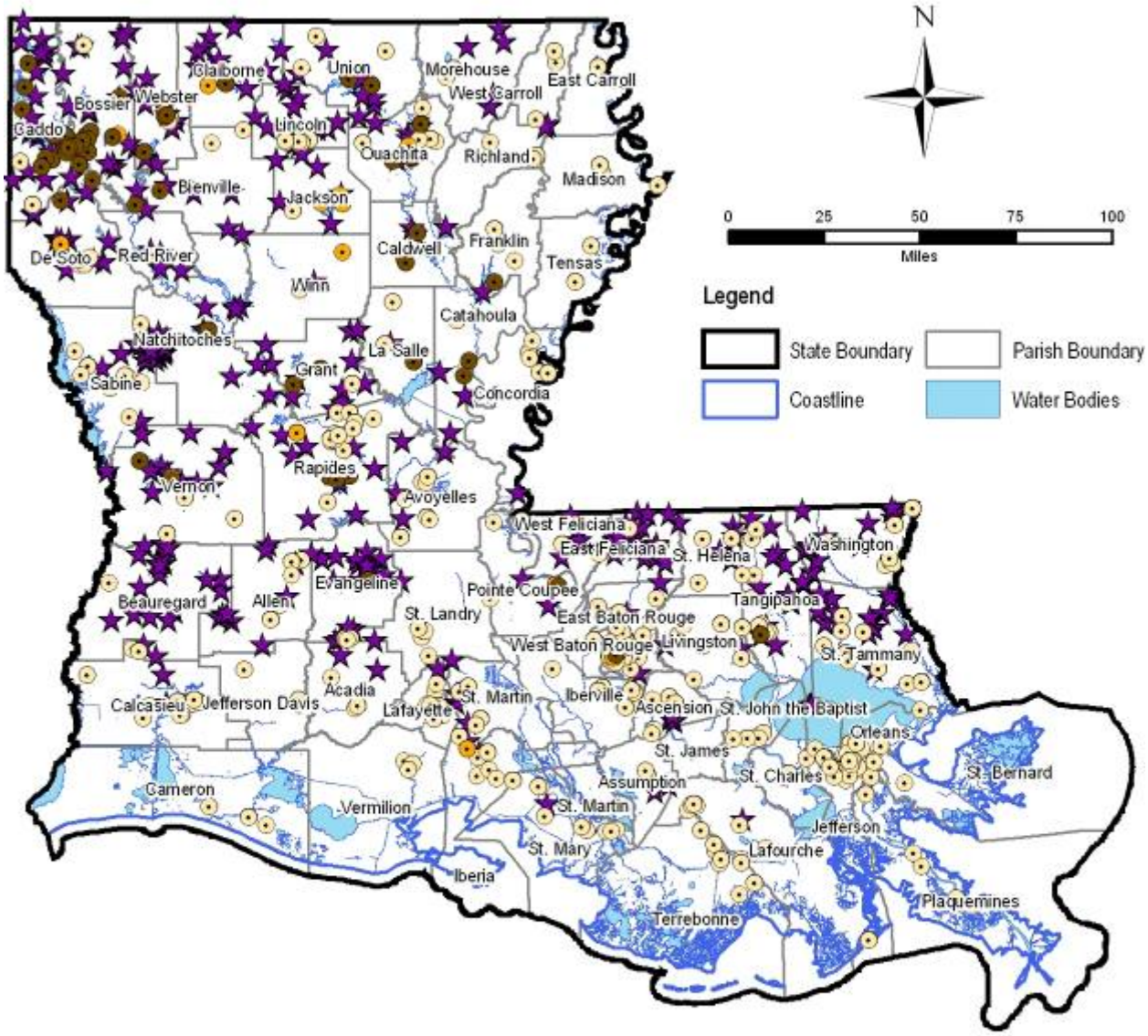
High (5% of Total) Medium (11% of Total) Low (84% of Total)

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-118: Loss Estimate - Dam Failure - Physical Damage



Estimated Losses

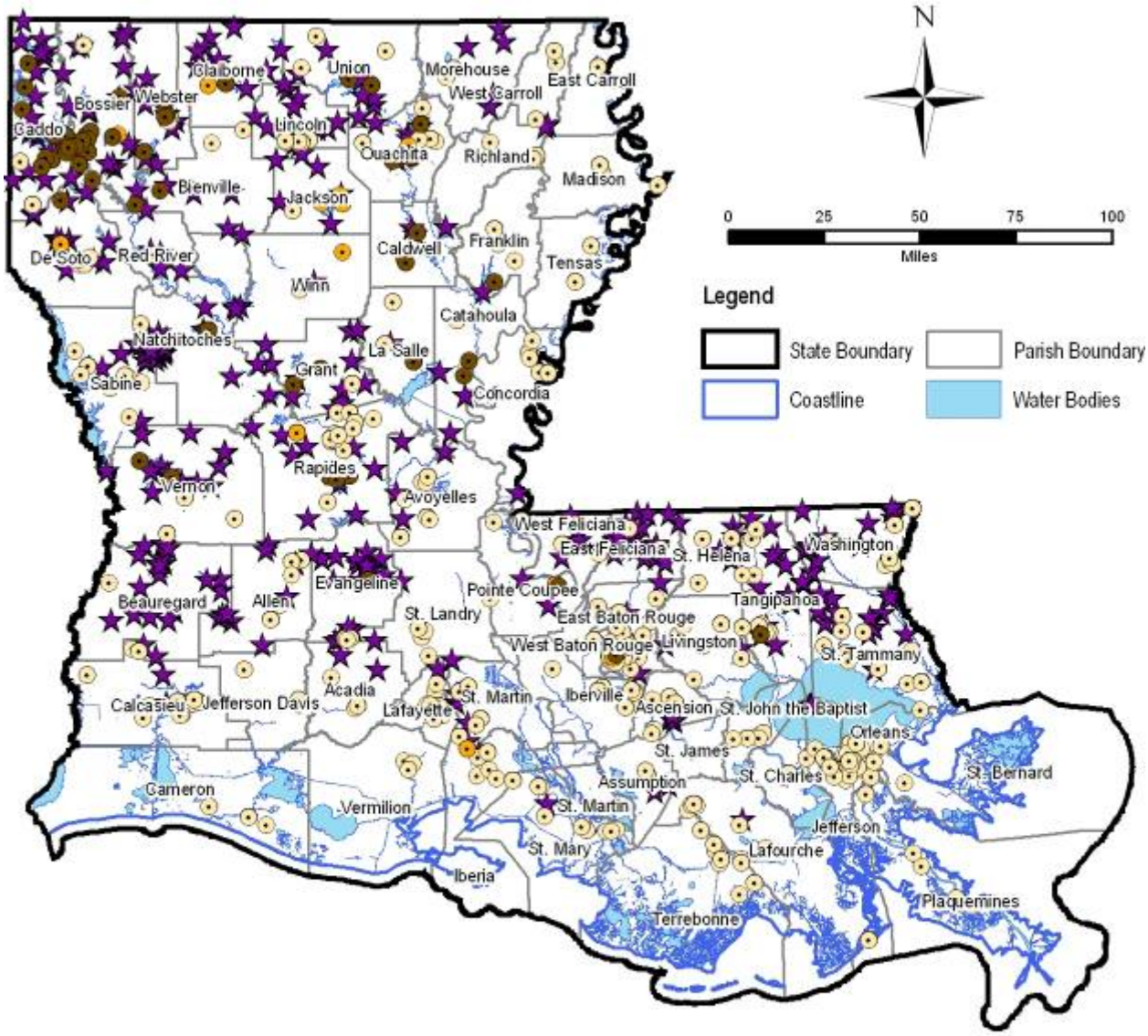
Low: $0 Medium: $1 - $7,500 High: $7,501 - $30,000,000

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-119: Loss Estimate - Dam Failure - Contents



Estimated Losses

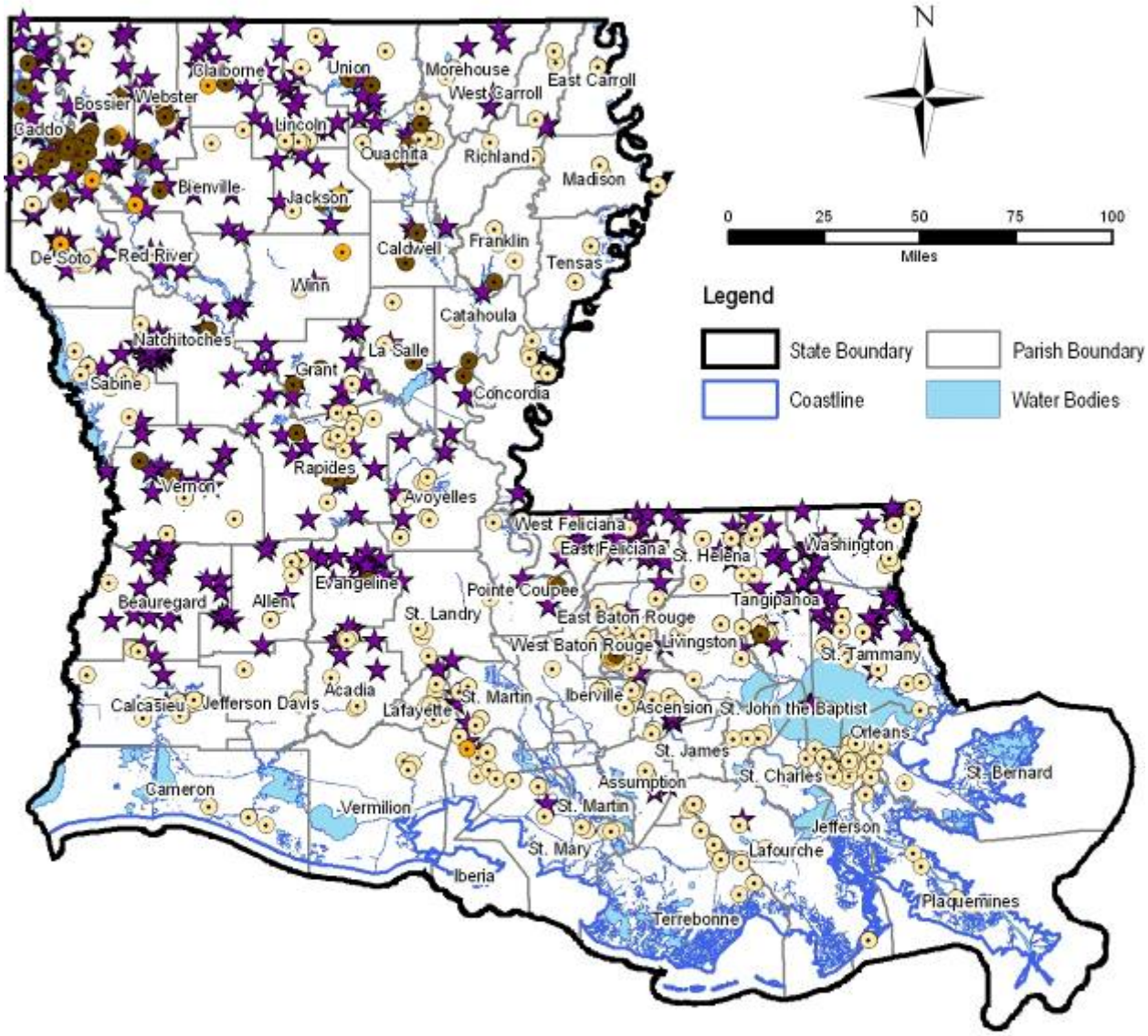
Low: $0 Medium: $1 - $5,000 High: $5,001 - $15,000,000

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-120: Loss Estimate - Dam Failure - Function



Estimated Losses

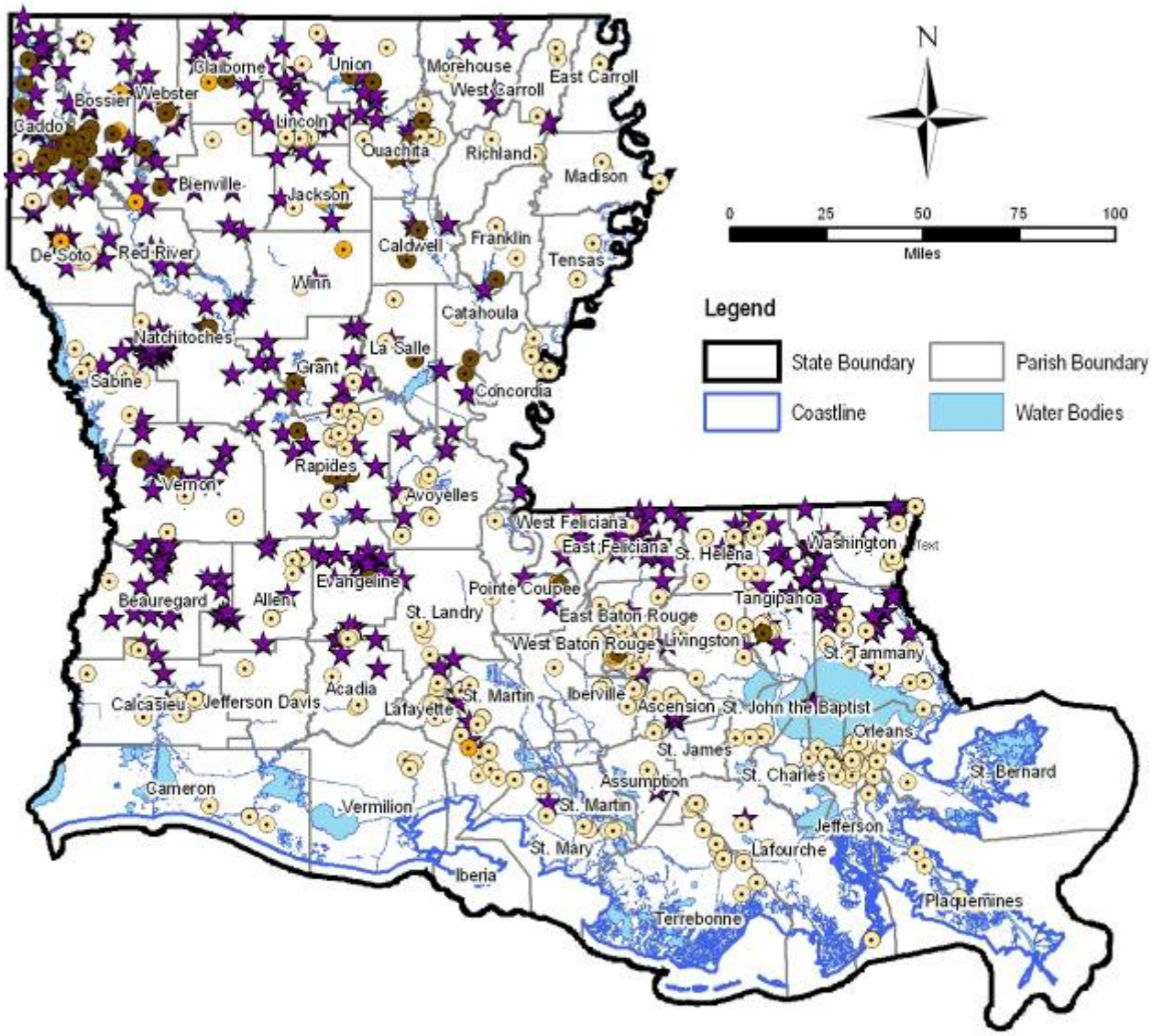
Low: $0 Medium: $1 - $17,500 High: $17,501 - $20,000,000

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-121: Loss Estimate - Dam Failure - Total



Estimated Losses

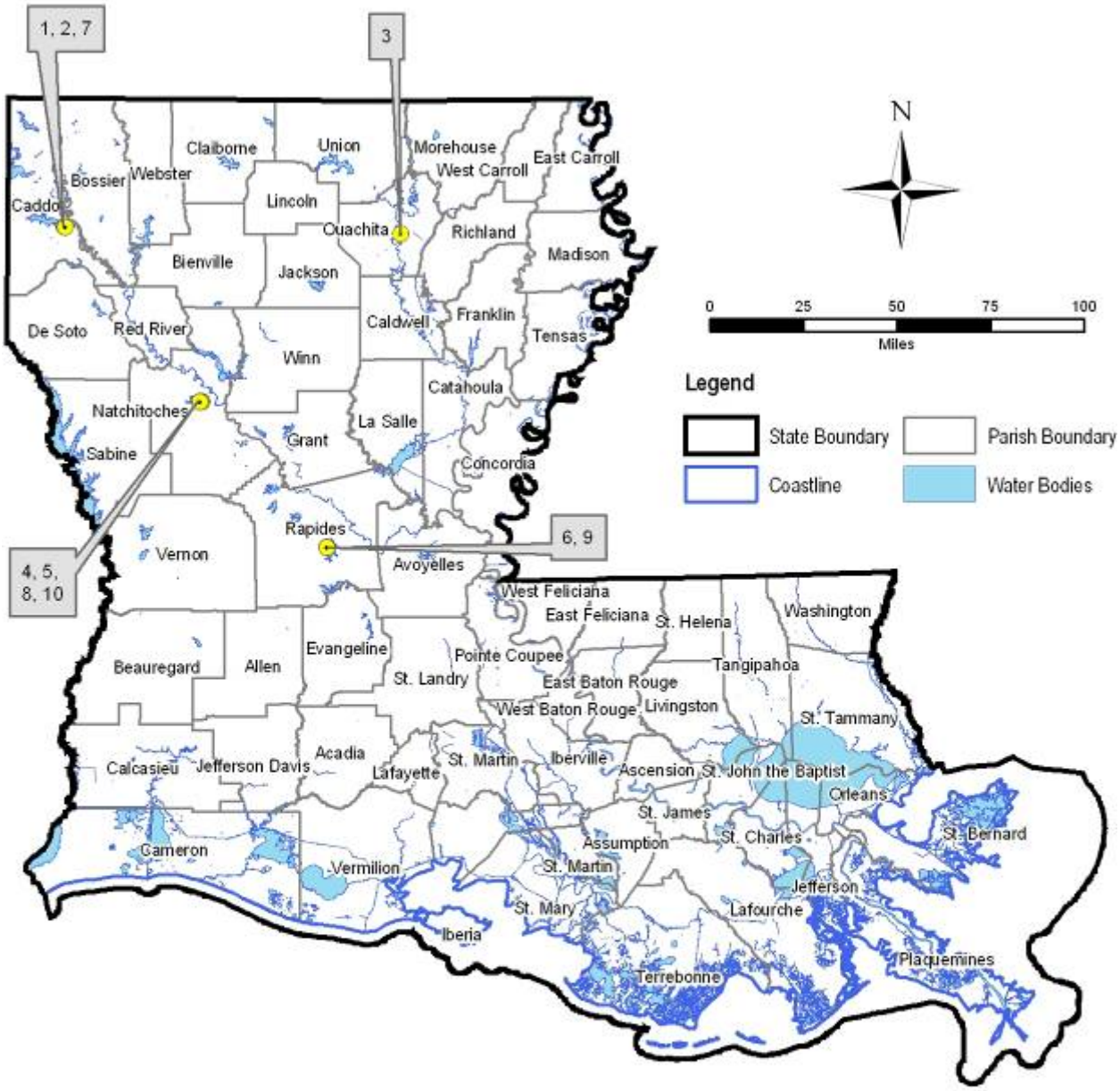
Low: $0 Medium: $1 - $50,000 High: $50,001 - $60,000,000

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

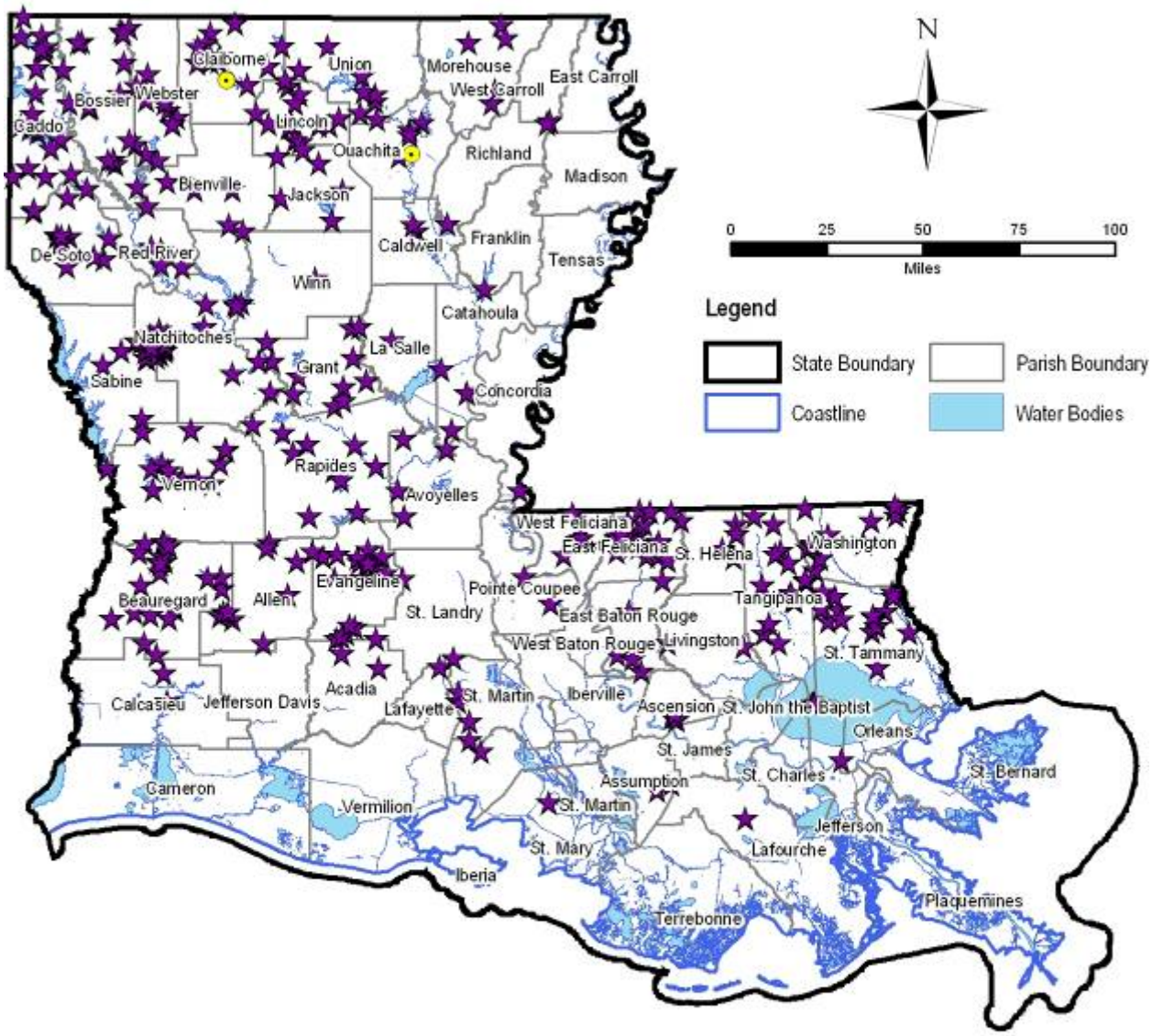
Map F-122: Loss Estimate - Dam Failure - Top Ten



⊙ Highest Loss Facilities

Source: Louisiana Facility Management Database

Map F-123: Loss Estimate - Dam Failure - Top 10 - Department of Public Safety and Corrections



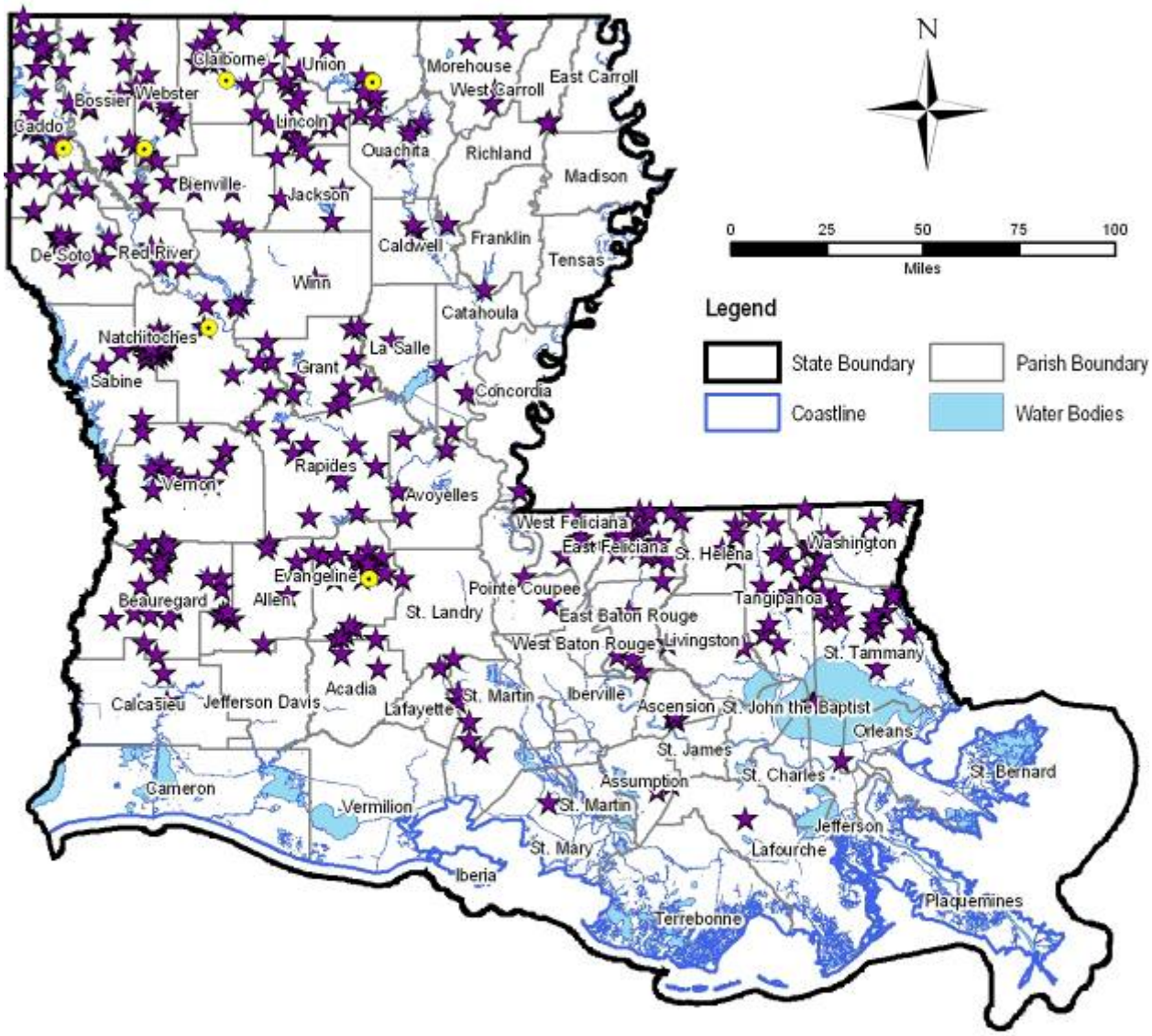
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-124: Loss Estimate - Dam Failure - Top 10 - Department of Culture, Recreation and Tourism



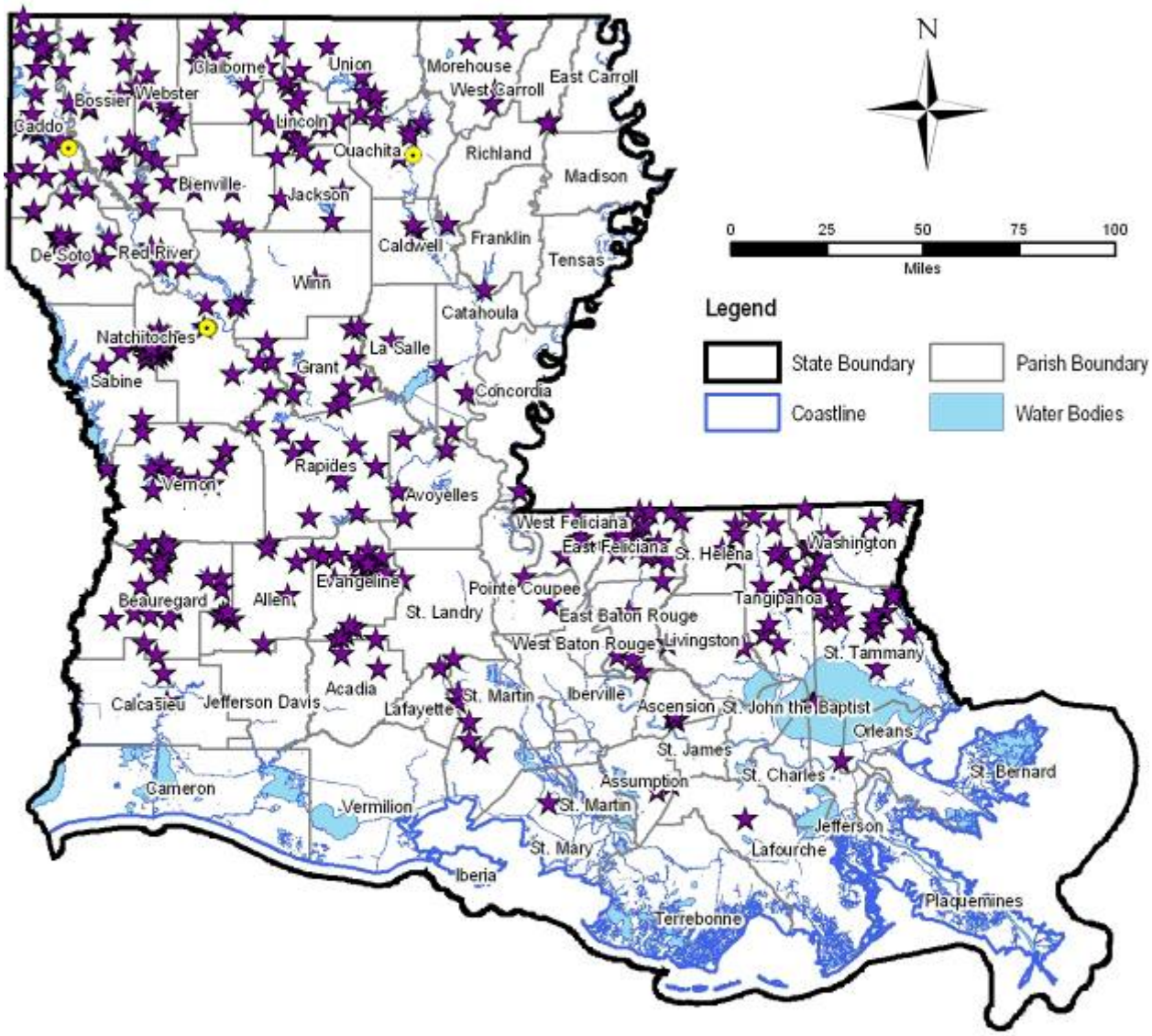
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-125: Loss Estimate - Dam Failure - Top 10 - Department of Education



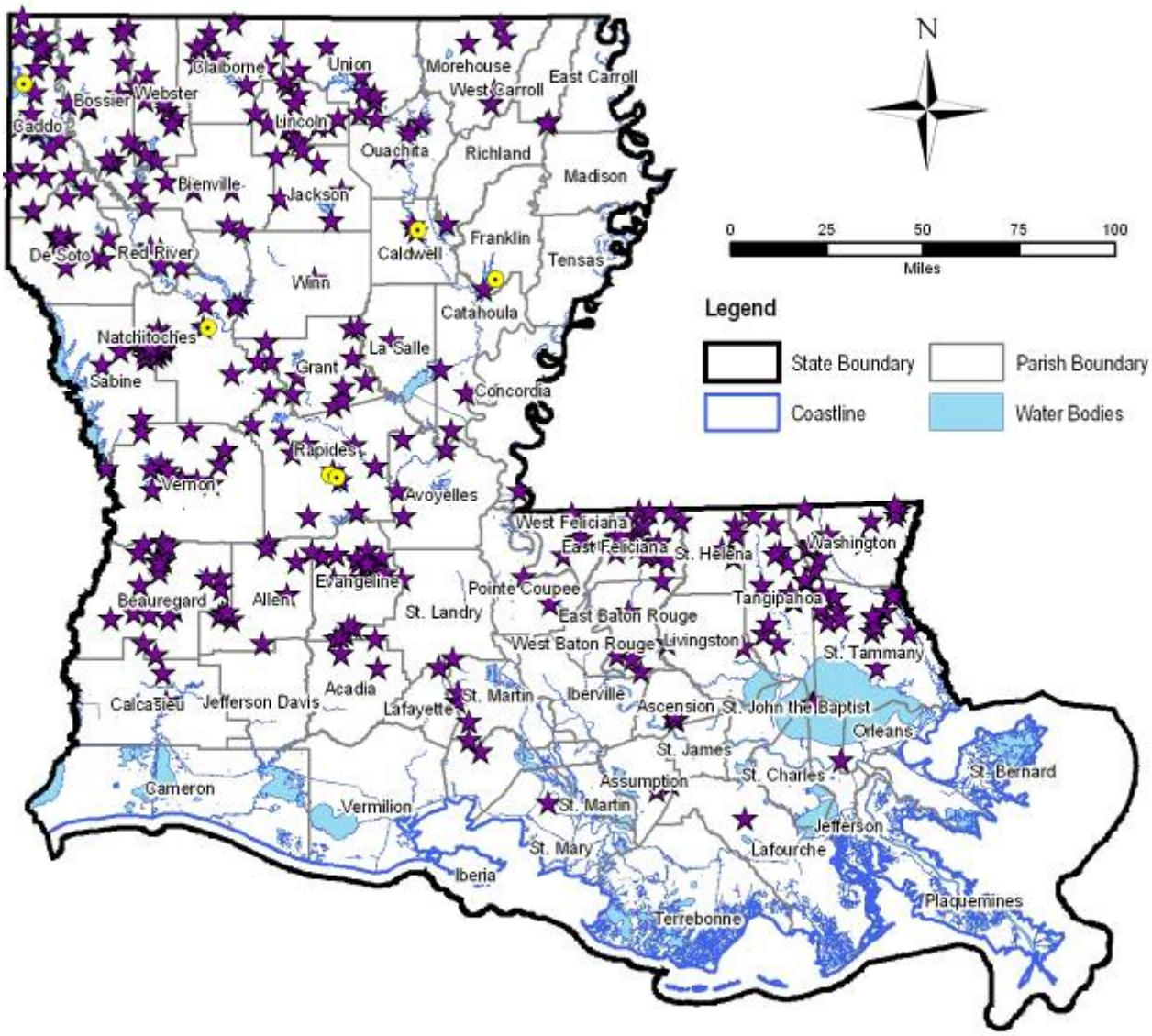
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-126: Loss Estimate - Dam Failure - Top 10 - Elected Officials



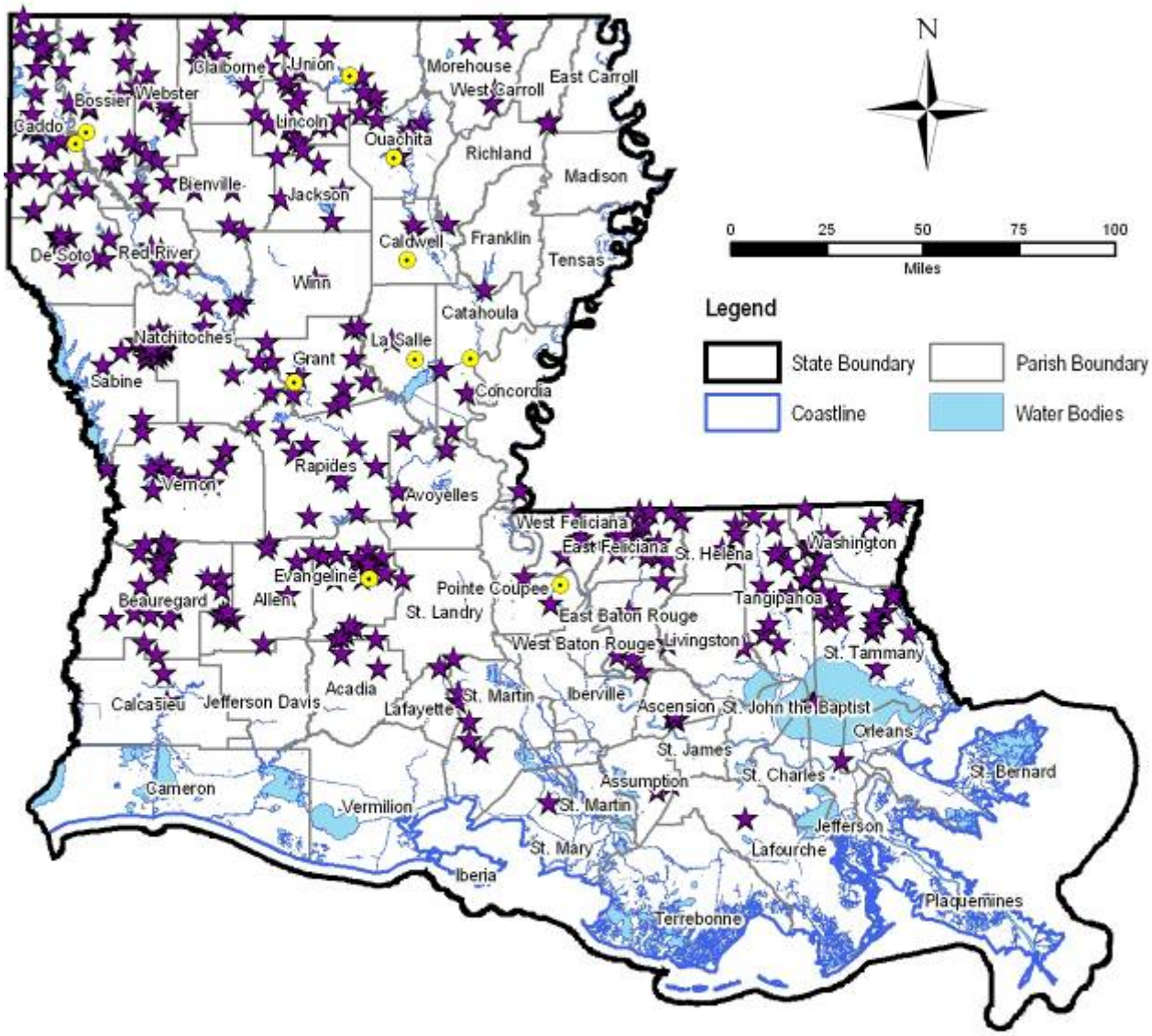
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-127: Loss Estimate - Dam Failure - Top 10 - Executive Department



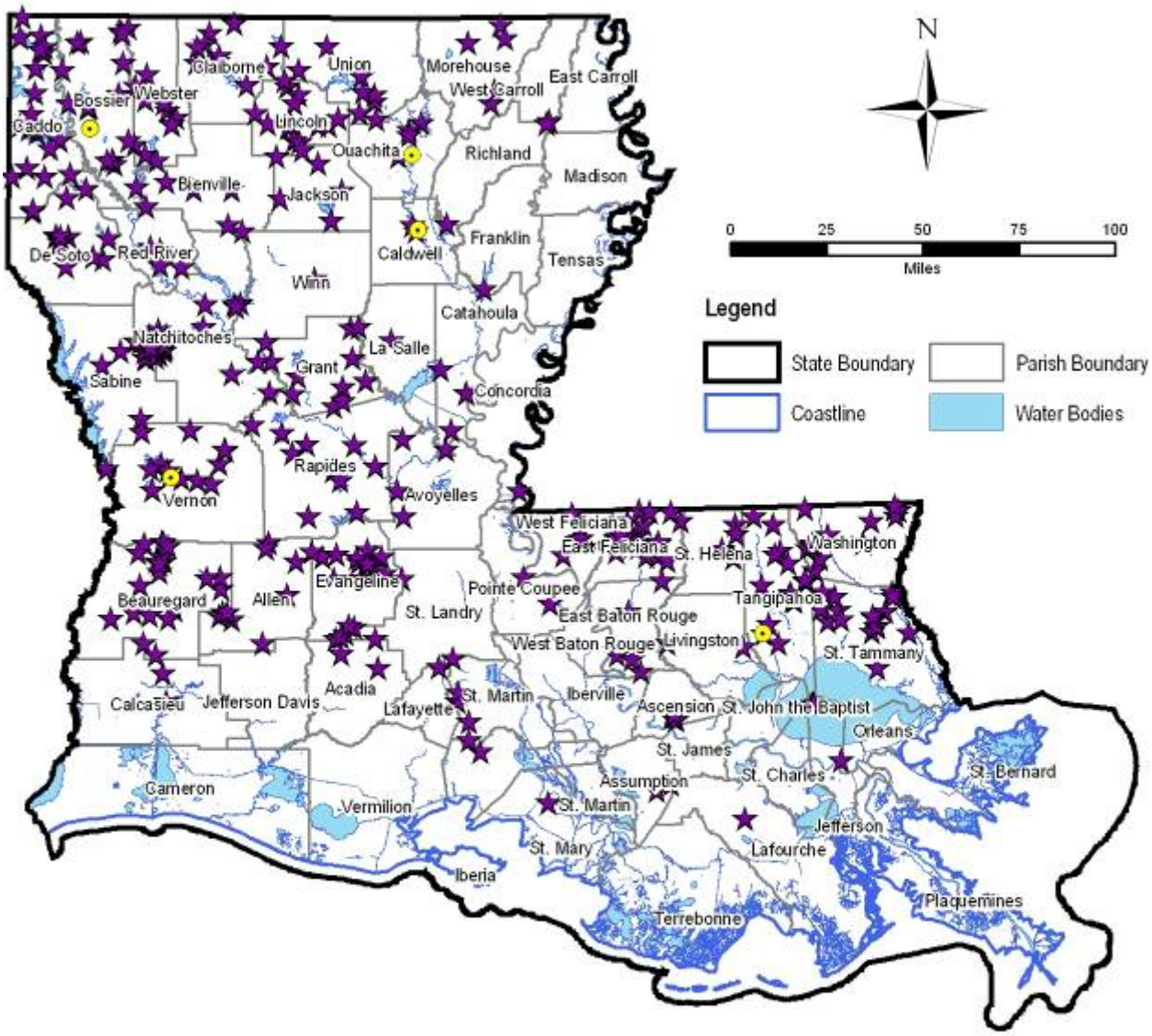
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-128: Loss Estimate - Dam Failure - Top 10 - Department of Health and Hospitals



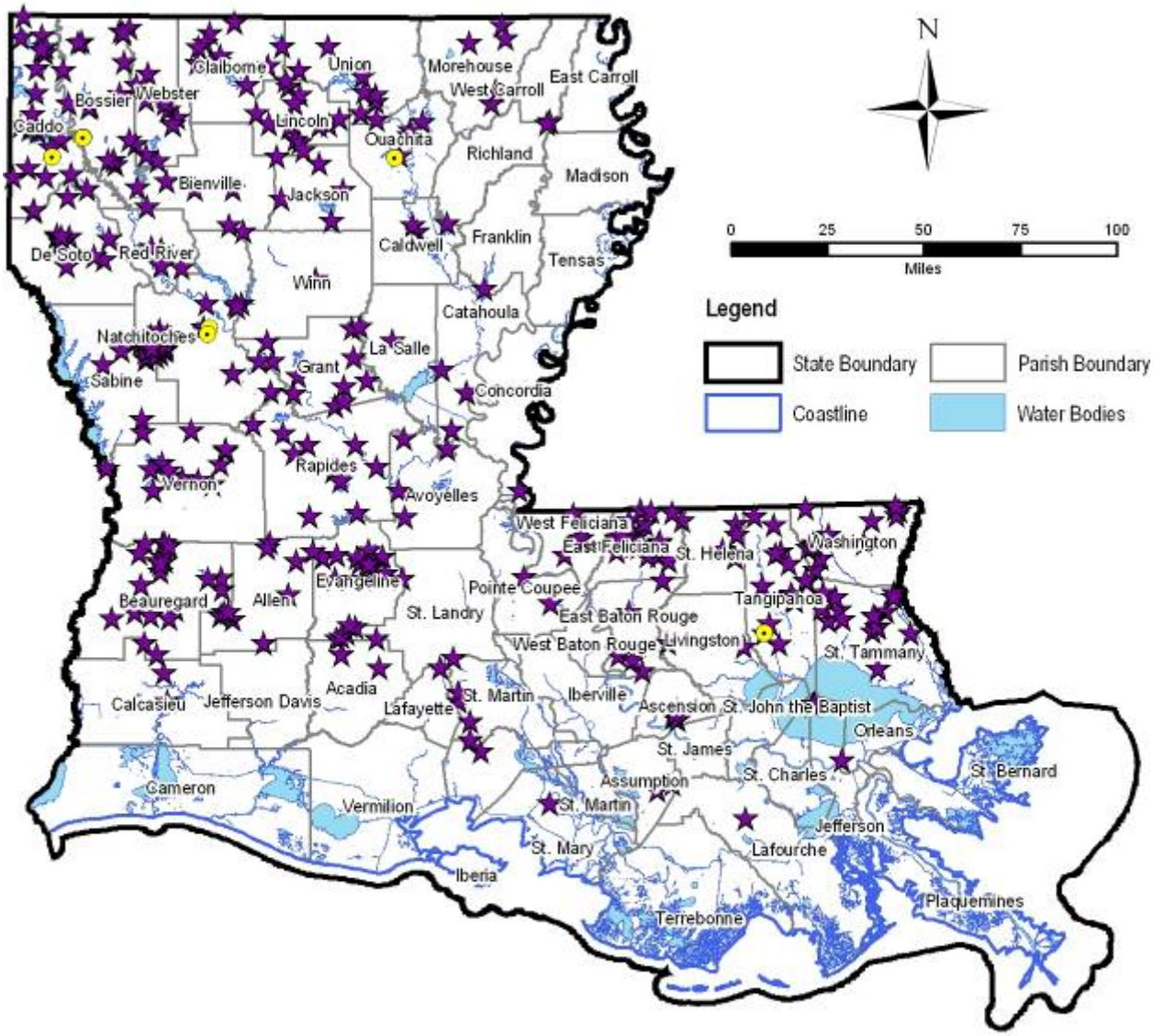
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-129: Loss Estimate - Dam Failure - Top 10 - Department of Transportation and Development



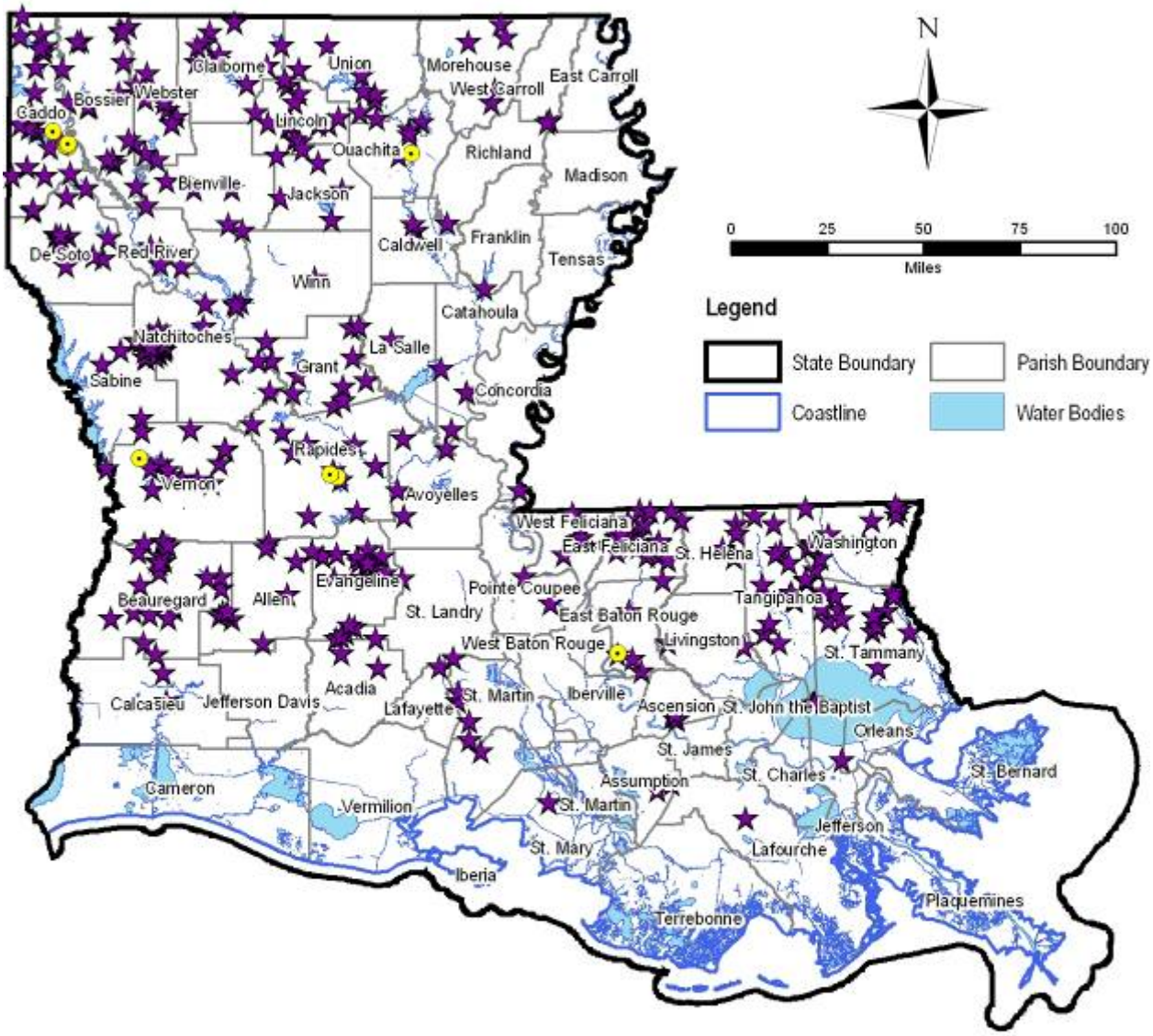
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-130: Loss Estimate - Dam Failure - Top 10 - Unknown Departments



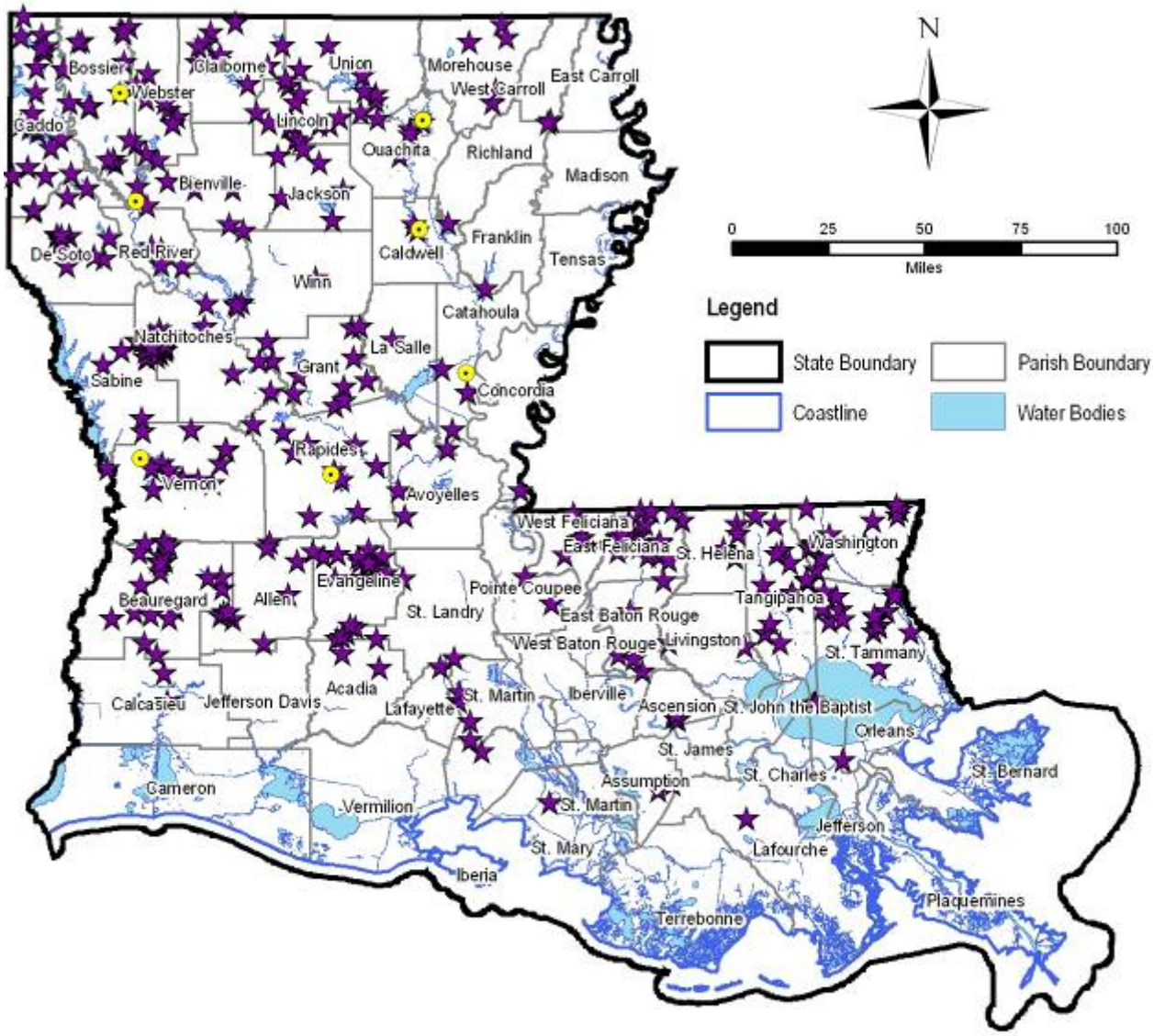
Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

Map F-131: Loss Estimate - Dam Failure - Top 10 - Department of Wildlife and Fisheries



Highest Loss Facilities

Source: Louisiana Facility Management Database

Dam Locations

Source: U.S. Army Corp of Engineers National Inventory of Dams

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